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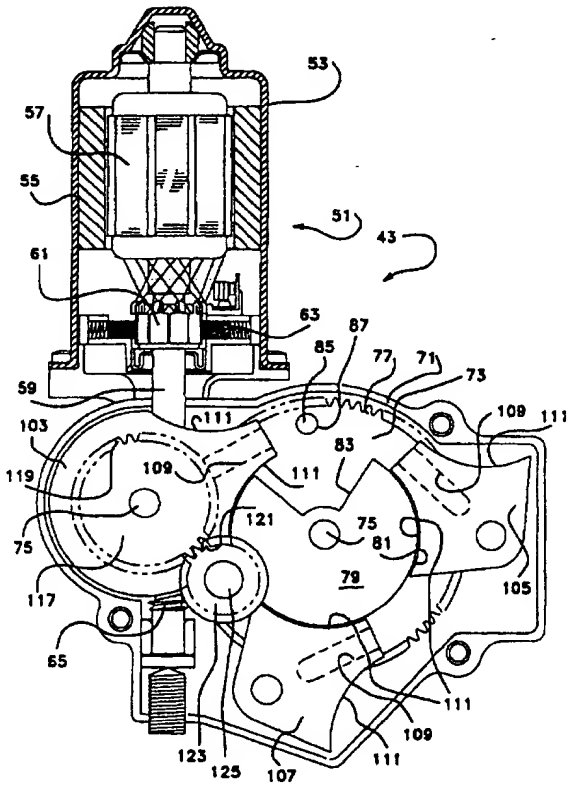
(57) Abstract

A multi-functional apparatus (43) employs a plurality of intermittent motion mechanisms. A single electromagnetic device selectively causes movement of the intermittent motion mechanisms thereby moving mechanical devices coupled thereto. In a specific embodiment of the invention, the armature shaft (59) of an electric motor (51) rotates a worm gear segment (65) which then drives a helical gear (73) mounted in a gear housing (71). Via a series of pins, cams and gears, also mounted in the housing (71), this input can be made to drive selectively two or three intermittent rotary motion mechanisms (125, 107, 105) according to the rotary position of the helical gear (73). Mechanical devices which are coupled to the intermittent rotary motion mechanisms, e.g. a rear window wiper, a liftgate lock and a liftgate window release lock, are therefore operated according to the positional range of oscillation or movement of the helical gear (73). In this way, the number of electromagnetic devices, or motors, required to be fitted to a vehicle liftgate is reduced.



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MULTI-FUNCTIONAL APPARATUS EMPLOYING AN INTERMITTENT MOTION MECHANISM

CROSS REFERENCE TO RELATED APPLICATIONS

This application relates to the following simultaneously filed patent applications which are incorporated by reference herewithin: U.S. Application Serial No. 08/431,148 entitled "Multi-Functional Apparatus Employing an Electromagnetic Device" by H. Winston Maue and Eric J. Krupp; and U.S. Application Serial No. 08/431,149 entitled "Control System for an Automotive Vehicle Multi-Functional Apparatus" by H. Winston Maue, Shawn P. Slusser, Jeffrey L. Kulczycki and Ronald Zaleski.

BACKGROUND OF THE INVENTION

This invention relates generally to multi-functional apparatuses and specifically to a multi-functional apparatus employing an intermittent motion mechanism for use in an automotive vehicle.

Almost all automotive vehicles have a single or a pair of windshield wiper assemblies. These assemblies traditionally include rubber wiper blades mounted upon claw brackets. These claw brackets are attached to wiper arms mounted upon rotating shafts. These shafts are either directly driven by electric motors or driven by a single electric motor which actuates series or parallel-coupled four-bar linkage mechanisms. It is further known to provide a wiper system, in combination with a wash device, to clean headlamps for automotive vehicles.

It is also common to employ a window wiper assembly for cleaning rear windows of automotive vehicles. Typically, these types of rear window wiper assemblies include a wiper blade mounted upon a bracket which is coupled to a wiper arm. The wiper arm is attached to a wiper shaft rotatably driven in a cyclical oscillating manner by a helical gear. A reversible, fractional horsepower, dc electric motor serves to actuate the helical gear through an armature shaft-mounted worm gear enmeshed therewith. This type of rear window wiper arrangement is usually mounted upon a pivoting liftgate of a

minivan, station wagon, sport-utility vehicle or the like. Examples of conventional window wiper assemblies and motor mechanisms are disclosed with the following U.S. Patents: 4,893,039 entitled "Windshield Wiper Motor" which issued to Isii on January 9, 1990; 4,878,398 entitled "Driving Device for Window Wiper of Motor Vehicles" which issued to Heinrich on November 7, 1989; 4,336,482 entitled "Rear Window Wiper Motor Control" which issued to Goertler et al. on June 22, 1982; 4,259,624 entitled "Arrangement for Wiping a Vehicle Window" which issued to Seibicke on March 31, 1981; 3,694,723 entitled "Motor Vehicle Windshield Wiper Having a Parking Position Outside the Wiper Area" which issued to Schneider et al. on September 26, 1972; and, 3,665,772 entitled "Windshield Wiper Motor Link Depressed Park Mechanism" which issued to Beard et al. on May 30, 1972. All of these patents are incorporated by reference herewithin.

Some conventional vehicles also provide a rear window release lock or latch, actuated by a solenoid, which can be unlocked to allow for upward pivotal movement of the rear window in relation to the otherwise stationary liftgate. In combination therewith, a separate liftgate lock is often mounted upon the liftgate door for fastening the liftgate to the body to prevent inadvertent pivotal opening. This liftgate lock is traditionally operated by manual key or handle rotation, or through a separate electric motor or solenoid

Additionally, separate motors and solenoids are required to actuate passenger door locks, an antenna retraction mechanism, headlamp cover retraction mechanisms, a fuel filler door lock and other similar functions. The traditional need for such a multiplicity of electromagnetic devices has increased the automotive vehicle weight and cost while further proving difficult to package within the often small spaces provided. This added weight is especially detrimental when the window wiper mechanism, rear window lock and liftgate lock, as well as their distinct respective electromagnetic devices, are all incorporated within the pivoting liftgate. Not only is the piece cost increased due to this multiplicity of electromagnetic devices, but the assembly cost, part

number proliferation and handling costs, electrical wiring costs, objectional motor noise, and failure modes are increased.

SUMMARY OF THE INVENTION

In accordance with the present invention, the preferred embodiment of a multi-functional apparatus employs an intermittent motion mechanism. An electromagnetic device selectively causes movement of the intermittent motion mechanism thereby moving a mechanical device coupled thereto. In another aspect of the present invention a pair of intermittent rotary motion mechanisms are selectively rotated by a single reversible electric motor. In a further aspect of the present invention, a single electric motor selectively actuates three intermittent rotary motion mechanisms thereby causing three mechanical devices coupled thereto to operate.

The multi-functional apparatus of the present invention is advantageous over conventional systems since the present invention combines many different functions into a single apparatus. For example, the present invention multi-functional apparatus replaces the traditional separate rear wiper motor, liftgate lock motor and rear window lock solenoid. Accordingly, the present invention multi-functional apparatus significantly reduces the piece cost, assembly cost, part proliferation and handling costs, wiring costs, and battery current consumption as compared to conventional constructions. Furthermore, the multi-functional apparatus of the present invention significantly reduces weight and packaging space requirements while increasing the electrical and mechanical reliability of the affected systems. Objectional motor and solenoid noises are also reduced. Moreover, the present invention provides a means for mechanically locking the intermittent motion mechanisms and devices coupled thereto in fixed positions. Additional advantages and features of the present invention will become apparent from the following description and appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a front elevational view showing the preferred embodiment of a multi-functional apparatus of the present invention;

Figure 2 is a rear elevational view, with portions broken away therefrom, showing the preferred embodiment multi-functional apparatus of the present invention;

Figure 3 is a perspective view showing a power transmission assembly employed in the preferred embodiment of the present invention multi-functional apparatus;

Figure 4 is a fragmentary rear elevational view showing the preferred embodiment multi-functional apparatus of the present invention;

Figure 5 is a diagrammatic rear view showing the power transmission assembly mechanisms of the preferred embodiment multi-functional apparatus of the present invention in the beginning of a wipe position;

Figure 6 is a diagrammatic rear view showing the power transmission assembly of the preferred embodiment multi-functional apparatus of the present invention at the end of one direction of a wiping motion;

Figure 7 is a diagrammatic rear view showing the power transmission assembly of the preferred embodiment multi-functional apparatus of the present invention at the end of the depressed park position;

Figure 8 is a diagrammatic rear view showing the power transmission assembly of the preferred embodiment multi-functional apparatus of the present invention at the beginning of a liftgate unlocking motion;

Figure 9 is a diagrammatic rear view showing the power transmission assembly of the preferred embodiment multi-functional apparatus of the present invention at the completion of the liftgate unlocking motion;

Figure 10 is a diagrammatic rear view showing the power transmission assembly of the preferred embodiment multi-functional apparatus of the present invention at the beginning of a liftglass unlocking and release motion;

Figure 11 is a diagrammatic rear view showing the power transmission assembly of the preferred embodiment multi-functional apparatus

of the present invention at the completion of the liftglass unlocking and release motion;

Figure 12 is a diagrammatic front view showing a motor feedback circuit disk employed in the preferred embodiment multi-functional apparatus of the present invention;

Figures 13a-13c are electrical schematic diagrams showing a rear node for controlling the preferred embodiment of the present invention multi-functional apparatus;

Figure 14 is a diagrammatic rear elevational view showing a first alternate embodiment of the multi-functional apparatus of the present invention;

Figure 15 is a diagrammatic front view showing a second alternate embodiment of the present invention multi-functional apparatus; and

Figure 16 is a diagrammatic rear view showing a third alternate embodiment of the multi-functional apparatus of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

An automotive vehicle, such as a minivan or the like, has a rear liftgate door which can pivot about an upper pair of hinges coupled to the vehicle body structure. When the liftgate is pivoted to an open position, a cargo space is accessible from behind the vehicle. Such a liftgate is shown in Figure 1. Liftgate 31 has a rear window or backlite 33 pivotable between a closed position, substantially flush with the outer surface of liftgate 31, to an open position about upper hinges. A pair of pneumatic cylinders 35 act to push window 33 toward the open position when a lower portion of window 33 is released. The preferred embodiment of a multi-functional apparatus 41 of the present invention is mounted upon an inner surface of liftgate 31. The majority of apparatus 41 is hidden by an interior trim panel (not shown). Apparatus 41 includes a central drive and power transmission unit 43, a window wiper assembly 45, a window release latch or lock 47 and a liftgate lock 49, all of which are mounted upon liftgate 31. Examples of such locks (employing separate solenoids or motors, which would be removed in order to couple the lock mechanism for use with the present invention) are disclosed within the

following U.S. patents: 5,222,775 entitled "Power Operated Latch Device for Automotive Back Door" which issued to Kato on June 29, 1993; 4,422,522 entitled "Inertial Lock for Vehicle Door Latch" which issued to Slavin et al. on December 27, 1983; and, 3,917,330 entitled "Electric Lock Release" which issued to Quantz on November 4, 1975; all of which are incorporated by reference herewithin.

The construction of central drive and power transmission unit 43 is best illustrated in Figures 2-4. An electric motor 51 is of a conventional 12 volt fractional horsepower, dc electromagnetic variety having a metallic motor housing 53 within which are stationary permanent magnets 55, a rotatable armature 57 with wire windings, a rotatable armature shaft 59 joined to armature 57, a commutator 61 electrically connected to the wire windings and rotatable with armature shaft 59, a brush card assembly 63 and various electronic components, bushings and retainers. It will be appreciated to those skilled in the art that other electric motor constructions can readily be substituted for that shown. A worm gear segment 65 is provided upon a portion of armature shaft 59 extending beyond motor housing 53.

A gear housing 71 is also provided for receiving worm gear segment 65 and the immediately adjacent portions of armature shaft 59. A main helical gear 73 is also housed and rotatably journalled within gear housing 71. Gear housing 71 is preferably made from cast aluminum. A plurality of knurled steel journalling pins 75 are press fit or otherwise attached within machined openings of gear housing 71. The placement of these openings in relation to each other is important. Pins 75 can alternately be molded as part of plastic gears and cams.

Helical gear 73 has an external set of helically oriented teeth 77 projecting entirely therearound for meshing with worm gear segment 65. A drum 79 is mounted upon a face of helical gear 73 for rotating therewith. Drum 79 has a partially circular peripheral surface 81 interrupted by a clearance indentation 83. Drum 79 and helical gear 73 are coaxially aligned for rotation about their respective journalling pin 75. A drive pin 85 projects from a face of helical gear 73 substantially parallel to the adjacent journalling pin 75. Drive pin

85 has a cylindrical driving interface surface 87 thereabout. Of course, a rotatable sleeve may alternately surround drive pin 85. Other alternate driving interface means may be employed such as an integrally molded finger, screw, rivet, spring, rib, plural projections or other similar formations protruding from a face of peripheral portion of helical gear 73. Helical gear 73 is preferably injection molded from a polymeric material such as acetyl. An electrically conductive feedback disk 89 (see Figure 12) is retained to an inside face of helical gear 73 through ultrasonically rolled welding or insert molding. Feedback disk 89 is comprised of a set of copper alloy or brass alloy stamped contacts which are provided with differing conductive and nonconductive patterns depending on the specific positional ranges as will be discussed in greater detail hereinafter.

A power transmission assembly 101 of central drive and power transmission unit 43 employs three intermittent rotary motion mechanisms or cams 103, 105 and 107. Each cam has a single, linear, external open channel 109 defined by driven interfacing surfaces or walls therein. Driving interface surface 87 of drive pin 85 is selectively engagable against the walls defining channels 109 of each cam. Each cam is rotatable about its respective journalling pin 75. Furthermore, partially circular external surfaces 111 of each cam register with the partially circular peripheral surface 81 of drum 79. A relatively tight tolerance on these registering surfaces of about 1-2 thousandths of an inch is preferably used. Thus, unless each cam is aligned with indentation 83 of drum 79, partially circular peripheral surface 81 of drum 79 will act to prevent rotation of each cam. However, when indentation 83 of drum 79 aligns with an individual cam, concurrently with drive pin 85 engaging within a channel 109 of the same cam, continued rotation of helical gear 73 will cause the selectively coupled cam to rotate therewith. Moreover, the selectively coupled cam will have increased rotational acceleration as drive pin 85 moves closer to journalling pin 75 within channel 109. This rotational acceleration, then deceleration, achieves a desirable inertial ramping up and ramping down effect such that potentially harmful inertial stresses and cyclical fatigue within the

device coupled thereto are avoided. The diameter of drive pin 85 should match channel 109 width within half a thousandth of an inch.

Cam 103 additionally has a spur gear 117 stacked coaxially thereupon for simultaneous movement therewith. Spur gear 117 has a peripheral set of teeth 119 extending entirely therearound for enmeshing with a mating external set of teeth 121 extending entirely around a driven pinion gear 123. Pinion gear 123 rotates the output shaft. The window wiper shaft 125 extends from a rear face of pinion gear 123 for moving in concert therewith. Wiper shaft 125 is attached to pinion gear 123 through rivets, insert molding, knurled press fitting, et cetera. A window wiper arm 127 of wiper assembly 45 is mounted upon wiper shaft 125 in a conventional manner. Wiper shaft is preferably made from cold rolled steel. The system is designed to oscillate wiper assembly 45 at forty-five cycles per minute (round trip) but other cycle frequencies can be achieved.

A protuberance 131 projects from a rear face of cam 105 and engages with a lever 133 which, in turn, is attached to a liftgate lock rod 135. Protuberance 131, lever 133 and rod 135 are also considered to be lock couplings or coupling members. Lock connecting rod 135 is joined to liftgate lock 49 (see Figure 1) for causing the mechanisms therein to move in response to movement of cam 105. Similarly, a protuberance 137 extends from and moves with a rear face of cam 107. A lever 139 is connected to protuberance 137 for moving therewith. A liftgate window release lock connecting rod 141 connects lever 139 to liftgate window release lock 47 (see Figure 1) for causing window releasing movement thereof in response to selective movement of cam 107. Protuberance 137, lever 139 and connecting rod 141 are also defined as liftgate window release lock couplings or coupling members. Protuberances 131 and 137 are preferably secured to their respective levers 133 and 139 in a keyholed manner. Additional threaded nuts, push nuts, crimpings, cotter pins and washers or the like (not shown) may be employed to retain the levers to their protrusions. The cams, spur gear and pinion gear are preferably made from powdered metallic steel. Alternately, other coupling means may be

employed such as cables, belts, chains, gear sets, multiple linkages, jack screws, rack and pinion gear sets or the like.

The operation of the multi-functional apparatus of the present invention can best be understood by referring to Figures 5-12. In Figure 5, drive pin 85 has partially entered channel 109 of cam 103. In this position, the wiper blade is moved 6° from a depressed park position 201 (see Figures 1 and 12) to the beginning of the window wipe range designated as position 203 (see Figure 12). Figure 6 shows helical gear 73, drive pin 85, cam 103, spur gear 117 and pinion gear 123 rotated 162° to the completion position 205 (see Figures 1 and 12) at the end of the window wipe range. The electrical polarity is then reversed to motor 51 (see Figure 2) such that rotation of helical gear 73, drive pin 85, cam 103, spur gear 117, pinion gear 123 and wiper shaft 125 are reversed back to helical gear position 203 (see Figure 12). Referring to Figure 7, helical gear 73 is rotated such that drive pin 85 moves cam 103, spur gear 117, pinion gear 123, wiper shaft 125 and wiper assembly 45 to the depressed wiper arm parking position 201 (see Figures 1 and 12). The wiper blade is thus moved off of the rear liftgate window such that the wiper blade is supported on a bracket upon the liftgate door. This allows for free, noninterferred movement of the lift glass window as will be discussed hereinafter.

Figure 8 illustrates helical gear 73 and drive pin 85 moved to the beginning of a liftgate lock/unlock positional range 207 (see Figure 12). Subsequently, Figure 9 shows helical gear 73 and drive pin 85 rotated to the completion of the liftgate lock/unlock positional range 207. Clockwise movement (as illustrated) of helical gear 73 through range 207 causes cam 105 to move to an unlocked orientation thereby causing the couplings and liftgate lock 49 (see Figure 1) associated therewith to also be moved from a locked orientation to an unlocked orientation. Motor 51 (see Figure 2) can then be reversed to move helical gear 73 in a counterclockwise direction (as illustrated); this causes drive pin 85, cam 105, the couplings and liftgate lock 49 (see Figure 1) to move from an unlocked orientation to a locked orientation.

In Figure 10, helical gear 73 and drive pin 85 are shown rotated to the beginning of a liftgate window release positional range 112 (see Figure

12). In this position, drive pin 85 engages cam 107. Helical gear 73, drive pin 85 and cam 107 are then rotated to the completion of the liftgate window release range 211 (see Figure 12) as is shown in Figure 11. This causes the couplings and window release lock 47 (see Figure 1) to move from a locked orientation to an unlocked orientation. After a pause, motor 51 (see Figure 2) is automatically reversed. Of course, it will be appreciated that the previously discussed positional ranges may have alternate patterns and arrangements, and may include additional or replacement functions.

As can best be observed in Figures 13a-c an electronic control unit includes a rear node microprocessor 605 preferably using a Motorola MC68HCO5V6 (or alternately MC68HCO5V7) chip mounted upon a rigid printed circuit board. Rear node electronic control unit is electrically connected to a central body microprocessor or control unit (not shown) in a multiplexed (MUX) fashion through a wire harness 403. A J1850 MUX protocol is used. Microprocessor 605 allows for energization of motor 51 (see Figure 2) through leads 601 in response to various wiper activation inputs received from the main body microprocessor, a liftgate mounted lock switch 351, a liftgate mounted liftglass release button switch 603 and various other ajar and positional switches. Three active electrical contactors 323 plus a common ground ride against the conductive pattern of feedback disk 89 (see Figure 12) for sensing the rotational position of helical gear 73 and motor 51 (see Figure 2). Rear node microprocessor 605 will translate the monostropic code (i.e.: requiring only a single bit to change when feedback disk 89 passes from any positional range to an adjacent positional range) pattern input signals from contactors 323 into a gray binary code. Upon reaching the completion of the window wipe positional range, upon reaching the completion of the liftgate window release positional range or upon receiving a vehicle occupant created signal from the central body microprocessor, rear node microprocessor 605 will actuate a normally closed relay 325 allowing for a reversal of the electrical polarity, and thus rotational direction of the armature 57 within motor 51 (see Figure 2). It should be noted that a lost motion mechanism may be required for allowing manual key-induced overriding of the lock mechanisms.

A first alternate embodiment of the multi-functional apparatus of the present invention is partially shown in Figure 14. In this embodiment, a worm gear segment 801 of a fractional horsepower, dc electric motor armature drives a helical gear 803 enmeshed therewith. A pair of drive pins 805 project from a face of helical gear 803. A drum 807 having a partially circular peripheral surface 809 with a pair of indentations 811 is coaxially mounted upon helical gear 803 for rotation therewith. Drum 807 further has a bifurcated fork 813 radially projecting therefrom and extending between the pair of drive pins 805. This embodiment also employs three starwheel-type intermittent rotary motion mechanisms 831, 833 and 835. A spur gear 841 is stacked upon starwheel mechanism 831 for rotation therewith. Spur gear 841 rotatably drives a pinion gear 843 which is engaged with a wiper shaft. Drive pins 805 and bifurcated fork 813 can be selectively rotated by the motor to engage with the teeth of the desired starwheel mechanism. Otherwise, this embodiment functions the same as the preferred embodiment.

A second alternate embodiment is shown in Figure 15. A multi-functional apparatus of the present invention employs a drive and power transmission unit 901 like that of the preferred embodiment to selectively and intermittently drive an output gear 903 which operates a headlamp washer fluid pump. Such a washer pump is disclosed within the following U.S. Patents: 4,173,055 entitled "Windshield Washer Pump Drive Mechanism" which issued to Izumi et al. on November 6, 1979; and 3,574,882 entitled "Windshield Washer Pump Assembly" which issued to Petry on April 13, 1971; both of which are incorporated by reference herewithin. A second intermittent motion mechanism selectively drives a second output gear 907 which moves a headlamp mechanism 909. Such a headlamp mechanism can comprise a rotatable headlamp cover having a pivoting cammed surface with gear teeth thereon. Alternately, the headlamp mechanism may consist of a retractable headlamp and bracket assembly such as those disclosed within U.S. Patents 5,355,286 entitled "Retractable Headlamp Assembly" which issued to Flint et al. on October 11, 1994; and 5,251,114 entitled "Actuator for Controlling the Orientation of a Motor Vehicle Headlamp" which issued to Cantin et al. on

October 5, 1993; both of which are incorporated by references herewithin. A third intermittent motion mechanism selectively drives a third output gear 911. This output gear 911 serves to rotate a headlamp wiper assembly 913 in a cyclically oscillating manner. A front node electronic control unit controls the actuation of an electric motor to selectively drive the intermittent motion mechanisms. The output gears may need to be of a bevel gear variety due to differently angled driven devices.

A third alternate embodiment of the present invention multi-functional apparatus is shown in Figure 16. A drive and power transmission unit 951, similar to that of the preferred embodiment, is disposed within a trunk of an automotive vehicle. A dc electric motor is selectively driven by a rear node electronic control unit to selectively activate a first intermittent motion mechanism. This first intermittent motion mechanism drives an output mechanism or pulley 953 which, in turn, moves a cable 955 to extend and retract a telescoping antenna 957. Examples of such telescoping antennas are disclosed within the following U.S. Patents: 3,803,627 entitled "Motor-Driven, Telescoping Antenna for Automobiles" which issued to Schuscheng on April 9, 1974; and 2,926,351 entitled "Power-Operated Antenna" which issued to Wise on February 23, 1960; the disclosures of which are incorporated by reference herewithin. The motor also selectively operates a second intermittent motion mechanism coupled to a pulley assembly 971 for moving a coupling such as a cable 975. Cable 975 is coupled to a trunk lock 977. Other coupling means may of course be employed. A fuel filler door lock and rear window wiper may also be coupled to the present invention multi-functional apparatus through intermittent motion mechanisms.

While various embodiments of this multi-functional apparatus have been disclosed, it will be appreciated that various modifications may be made without departing from the present invention. For example, a solenoid, electromagnet or other electromagnetic devices may be used in place of the previously described electric motor. Furthermore, additional spur gears, pinion gears, sector gears, planetary gears, jack screws, sprockets and chains, pulleys and belts, cables or other force transmitting means may be employed

to couple between the electromagnetic device, rotatable member, intermittent motion mechanisms or locks. Moreover, a multiple gear transmission, linkage, belt or cable system can alternately couple a wiper assembly to the wiper shaft. It will further be appreciated that a variety of other multiplexed or non-multiplexed, microprocessor or analog circuitry may be used to control the apparatus of the present invention. The intermittent motion mechanisms may also be accomplished by employing other known intermittent motion mechanisms such as more conventional Geneva mechanisms, intermittent gearing, escapements, ratchet mechanisms or other known selectively actuable devices. For example, reference should be made to the following U.S. patents which are incorporated by reference herewithin: 5,228,239 entitled "System for Automatically Opening and Closing Doors of Vehicles" which issued to Heo on July 20, 1993; 4,352,299 entitled "Intermittent Motion Gear Apparatus" which issued to Riggs et al. on October 5, 1982; 3,443,455 entitled "Intermittent Motion Device" which issued to Zugel on May 13, 1969; 3,443,442 entitled "Selectively Operable Intermittent Motion Apparatus" which issued to Schweihs on May 13, 1969; 3,442,146 entitled "Intermittent Rotary Motion" which issued to Simpson on May 6, 1969; and 3,421,380 entitled "Intermittent Motion Apparatus" which issued to Mansour on January 14, 1969. The multi-functional apparatus of the present invention can further be employed for windshield wipers, side door locks or other automotive vehicle and non-automotive vehicle applications. Moreover, the present invention can operate a backlite wiper in a hatchback or fixed backlight sedan. While various materials, electronic components, circuits and force transmitting members have been disclosed, a variety of other such materials, electronic components, circuits and force transmitting devices may be used. It is intended by the following claims to cover these and any other departures from the disclosed embodiments which fall within the true spirit of this invention.

The invention claimed is:

1. A multi-functional automotive vehicle apparatus comprising:

a rotatable member having at least one driving interface surface thereon;

an electromagnetic device selectively rotating said rotatable member;

a first intermittent rotary motion mechanism having a driven interfacing surface thereof engagable with said at least one driving interface surface for changing orientation of said first intermittent motion mechanism; and

a second intermittent rotary motion mechanism having a driven interfacing surface thereof engagable with said at least one driving interface surface for changing orientation of said second intermittent motion mechanism.

2. The multi-functional apparatus of Claim 1 wherein:

said rotatable member is further defined as a main gear with a set of external teeth; and

said at least one driving interface surface is further defined as a drive pin projecting substantially parallel to a rotational axes of said main gear.

3. The multi-functional apparatus of Claim 2 wherein said intermittent motion mechanisms are rotatable less than 190° about first and second pivot axes.

4. The multi-functional apparatus of Claim 3 wherein said intermittent motion mechanisms are further defined as cams and said driven interfacing surfaces are further defined as sidewalls of a single, linear, externally open channel disposed within each of said cams.

5. The multi-functional apparatus of Claim 1 further comprising:

a wiper output shaft;

a wiper gear coupled to said wiper output shaft for supplying oscillating pivotal movement thereto; and

said first intermittent motion mechanism having external gear teeth extending therefrom for enmeshing with said wiper gear thereby intermittently supplying rotational movement thereto when said at least one driving interface surface is between first and second positions thereof.

6. The multi-functional apparatus of Claim 5 further comprising:

a wiper arm pivotably coupled to said wiper output shaft for movement therewith;

a wiper reverse position of said at least one driving interface surface being defined between said first and second positions thereof, said at least one driving interface surface being disposed between said first and wiper reverse positions, inclusive, during movement of said wiper blade throughout its normal oscillating window wiping cycle; and

said at least one driving interface surface being disposed at said second position to cause said wiper arm to be located in a park position.

7. The multi-functional apparatus of Claim 1 further comprising:

a lock coupling member movable between a locked orientation and an unlocked orientation; and

said at least one driving surface causing said second intermittent motion mechanism and said lock coupling member to move between said locked orientation and said unlocked orientation.

8. The multi-functional apparatus of Claim 7 further comprising:

a third intermittent motion mechanism;

a window release lock coupling member movable between a locked orientation and an unlocked orientation; and

said at least one driving interface surface causing said third intermittent motion mechanism and said window release lock coupling member to move between said locked orientation and said unlocked orientation.

9. The multi-functional apparatus of Claim 1 further comprising a third intermittent motion mechanism movable in response to movement of said at least one driving surface engagable therewith, said third intermittent motion mechanism disposed at an opposite end of a rotational path of said at least one driving surface from said first intermittent motion mechanism with said second intermittent motion mechanism disposed therebetween.

10. The multi-functional apparatus of Claim 1 wherein at least one of said intermittent motion mechanisms are further defined as a rotatable star wheel-type mechanism.

11. The multi-functional apparatus of Claim 1 wherein at least one of said intermittent motion mechanisms are further defined as a Geneva-type mechanism.

12. The multi-functional apparatus of Claim 1 further comprising:

a drum mounted on said rotatable member for moving therewith, said drum having a partially circular peripheral surface with a clearance indentation therein; and

partially circular external surfaces of said intermittent motion mechanisms registering with said partially circular peripheral surface of said drum such that each of said intermittent motion mechanisms are substantially prevented from rotating until a portion thereof is exposed to said clearance indentation of said drum;

whereby said intermittent motion mechanisms are substantially prevented from moving simultaneously.

13. The multi-functional apparatus of Claim 1 wherein said electromagnetic device is defined as a single, fractional horsepower, electric motor operable to rotate an armature shaft having a worm gear segment, said worm gear segment enmeshing with geared teeth on said rotatable member.

14. A multi-functional automotive vehicle apparatus comprising:

a rotatable member having driving interface means thereon;

a first intermittent rotary motion mechanism selectively engagable with said driving interface means;

a second intermittent rotary motion mechanism selectively engagable with said driving interface means; and

a third intermittent rotary motion mechanism selectively engagable with said driving interface means.

15. The multi-functional apparatus of Claim 14 wherein:

said rotatable member is further defined as a main gear with a set of external teeth; and

said driving interface means is further defined as a drive pin projecting substantially parallel to a rotational axes of said main gear.

16. The multi-functional apparatus of Claim 15 wherein said intermittent motion mechanisms are further defined as cams with each cam having a single, linear, externally open channel within which said drive pin is selectively engagable.

17. The multi-functional apparatus of Claim 14 further comprising:

a wiper output shaft;

a wiper gear coupled to said wiper output shaft for supplying oscillating pivotal movement thereto; and

said first intermittent motion mechanism having external gear teeth extending therefrom for enmeshing with said wiper gear thereby intermittently supplying rotational movement thereto when said at least one driving interface surface is between first and second positions thereof.

18. The multi-functional apparatus of Claim 17 further comprising:

a wiper arm pivotably coupled to said wiper output shaft for movement therewith;

a wiper reverse position of said at least one driving interface surface being defined between said first and second positions thereof, said at least one driving interface surface being disposed between said first and wiper reverse positions, inclusive, during movement of said wiper blade throughout its normal oscillating window wiping cycle; and

said at least one driving interface surface being disposed at said second position to cause said wiper arm to be located in a park position.

19. The multi-functional apparatus of Claim 14 further comprising:

a lock coupling member movable between a locked orientation and an unlocked orientation; and

said at least one driving surface causing said second intermittent motion mechanism and said lock coupling member to move between said locked orientation and said unlocked orientation.

20. The multi-functional apparatus of Claim 19 further comprising:

a third intermittent motion mechanism;

a window release lock coupling member movable between a locked orientation and an unlocked orientation; and

said at least one driving interface surface causing said third intermittent motion mechanism and said window release lock coupling member to move between said locked orientation and said unlocked orientation.

21. The multi-functional apparatus of Claim 14 further comprising:

a single electric motor driving said rotatable member;

feedback means for sensing a rotational position of said rotatable member; and

a microprocessor controlling energization of said motor and position of said rotatable member in response to said feedback means.

22. The multi-functional apparatus of Claim 14 wherein at least one of said intermittent motion mechanisms are further defined as a rotatable star wheel-type mechanism.

23. The multi-functional apparatus of Claim 14 wherein at least one of said intermittent motion mechanisms are further defined as a Geneva-type mechanism.

24. The multi-functional apparatus of Claim 14 further comprising:

a drum mounted on said rotatable member for moving therewith, said drum having a partially circular peripheral surface with a clearance indentation therein; and

partially circular external surfaces of said intermittent motion mechanisms registering with said partially circular peripheral surface of said drum such that each of said intermittent motion mechanisms are substantially prevented from rotating until a portion thereof is exposed to said clearance indentation of said drum;

whereby said intermittent motion mechanisms are substantially prevented from moving simultaneously.

25. A multi-functional apparatus for use in an automotive vehicle comprising:

an intermittent rotary motion mechanism;

means for coupling a lock to said intermittent rotary motion mechanism, said means for coupling movable between an unlocked orientation and a locked orientation; and

an electromagnetic device operable for selectively rotating said intermittent rotary motion mechanism thereby moving said means for coupling between said unlocked and locked orientations.

26. The multi-functional apparatus of Claim 25 wherein said lock fastens a rear liftgate to a body of said automotive vehicle.

27. The multi-functional apparatus of Claim 25 wherein said lock fastens a pivotable window in a closed orientation.

28. The multi-functional apparatus of Claim 25 further comprising means for drivably coupling said electromagnetic device to said intermittent rotary motion mechanism.

29. The multi-functional apparatus of Claim 25 wherein said intermittent rotary motion mechanism is further defined as a Geneva-type mechanism.

30. The multi-functional apparatus of Claim 25 wherein said intermittent rotary motion mechanism is further defined as a star wheel-type mechanism.

31. The multi-functional apparatus of Claim 25 further comprising a second intermittent motion mechanism selectively movable by said electromagnetic device for moving a window wiper shaft.

32. The multi-functional apparatus of Claim 25 further comprising a second intermittent motion mechanism selectively movable by said electromagnetic device for moving second means for coupling a second lock between an unlocked orientation and a locked orientation.

33. A multi-functional apparatus comprising:

a first intermittent rotary motion mechanism operable to move a lock coupling mechanism between an unlocked orientation and a locked orientation;

an electromagnetic device operable for selectively rotating said first intermittent rotary motion mechanism; and

a second intermittent rotary motion mechanism selectively rotatable by said electromagnetic device for moving a window wiper shaft.

34. The multi-functional apparatus of Claim 33 further comprising:

a third intermittent motion mechanism;

a window release lock coupling member movable between a locked orientation and an unlocked orientation; and

at least one driving interface surface causing a selected one of said intermittent rotary motion mechanisms and said third intermittent motion mechanism to move at a given time.

35. The multi-functional apparatus of Claim 33 wherein said electromagnetic device is defined as a single, fractional horsepower, electric motor operable to rotate an armature shaft having a worm gear segment, said worm gear segment enmeshing with geared teeth on a rotatable member.

36. The multi-functional apparatus of Claim 33 wherein said intermittent rotary motion mechanisms are further defined as cams with each cam having a single, linear, externally open channel.

37. The multi-functional apparatus of Claim 33 further comprising:

a wiper gear coupled to said wiper shaft for supplying oscillating pivotal movement thereto;

said first intermittent rotary motion mechanism having external gear teeth for enmeshing with said wiper gear thereby intermittently supplying rotational movement thereto; and

locking means for mechanically deterring movement of said second intermittent rotary motion mechanism during movement of said first intermittent rotary motion mechanism.

38. The multi-functional apparatus of Claim 33 further comprising:

a rotatable member driven by said electromagnetic device, said electromagnetic device being further defined as a single electric motor;

feedback means for sensing a rotational position of said rotatable member; and

a microprocessor controlling energization of said motor and position of said rotatable member in response to said feedback means.

39. A multi-functional apparatus for use in an automotive vehicle comprising:

a liftgate lock movable between a locked orientation and an unlocked orientation;

an intermittent rotary motion mechanism coupled to said liftgate lock;

an electric motor operable for selectively rotating said intermittent rotary motion mechanism thereby moving said liftgate lock between said locked and unlocked orientations;

a liftgate window release lock movable between a locked orientation and an unlocked orientation;

a second intermittent rotary motion mechanism selectively rotatable by said electric motor for moving said window release lock between said locked orientation and said unlocked orientation;

a rear window wiper shaft rotatable in an oscillating manner;

a third intermittent rotary motion mechanism selectively rotatable by said electric motor for moving said window wiper shaft.

40. A multi-functional apparatus comprising:

an antenna telescopically movable between an extended orientation and a retracted orientation;

an electromagnetic device;

an intermittent motion mechanism operably driven by said electromagnetic device; and

means for coupling said intermittent motion mechanism to said antenna whereby selective movement of said intermittent motion mechanism causes telescoping movement of said antenna.

41. The multi-functional apparatus of Claim 40 further comprising a second intermittent motion mechanism selectively driven by said electromagnetic device.

42. The multi-functional apparatus of Claim 41 further comprising a lock movable between a locked orientation and an unlocked orientation in response to movement of said second intermittent motion mechanism.

43. The multi-functional apparatus of Claim 40 wherein said intermittent motion mechanism is further defined as a Geneva-type mechanism.

44. The multi-functional apparatus of Claim 40 wherein said intermittent motion mechanism is further defined as a star wheel-type mechanism.

45. The multi-functional apparatus of Claim 40 wherein said intermittent motion mechanism is further defined as a rotatable cam having a channel therein with a single open end.

46. A multi-functional apparatus comprising:

a headlamp mechanism movable between an extended orientation and a retracted orientation;

an electromagnetic device;

an intermittent motion mechanism operably driven by said electromagnetic device; and

means for coupling said intermittent motion mechanism to said headlamp mechanism whereby selective movement of said intermittent motion mechanism causes movement of said headlamp mechanism.

47. The multi-functional apparatus of Claim 46 further comprising a second intermittent motion mechanism selectively driven by said electromagnetic device.

48. The multi-functional apparatus of Claim 47 further comprising a headlamp wiper assembly coupled to said second intermittent motion mechanism for moving therewith.

49. The multi-functional apparatus of Claim 48 further comprising a washer fluid pump also selectively driven by said electromagnetic device.

50. The multi-functional apparatus of Claim 46 wherein said headlamp mechanism is further defined as a headlamp cover.

51. The multi-functional apparatus of Claim 46 wherein said headlamp mechanism is further defined as a pivotable headlamp and bracket assembly.

52. The multi-functional apparatus of Claim 46 wherein said intermittent motion mechanism is further defined as a rotatable cam having a channel therein with a single open end.

53. The multi-functional apparatus of Claim 46 wherein said intermittent motion mechanism is further defined as a Geneva-type mechanism.

54. The multi-functional apparatus of Claim 46 wherein said intermittent motion mechanism is further defined as a rotatable star wheel-type mechanism.

55. A multi-functional power transmission assembly comprising:

a rotatable main gear having a set of external teeth therearound;

a drive pin projecting from a face of said main gear substantially parallel with an axis of rotation;

a drum mounted coaxially upon said main gear for moving therewith, said drum having a partially circular peripheral surface with a clearance indentation therein;

a first rotatable cam having a single, linear, externally open channel within which said drive pin is selectively engagable;

a second rotatable cam having a single, linear, externally open channel within which said drive pin is selectively engagable;

a third rotatable cam having a single, linear, externally open channel within which said drive pin is selectively engagable;

said drive pin only being selectively engagable with one of said channels at a time, rotation of said drive pin with said main gear causing an engaged one of said cams to rotate in response thereto; and

partially circular external surfaces of said cams registering with said partially circular peripheral surface of said drum such that each of said cams are substantially prevented from rotating until a portion thereof is exposed to said clearance indentation of said drum concurrently with engagement of said respective channel by said drive pin.

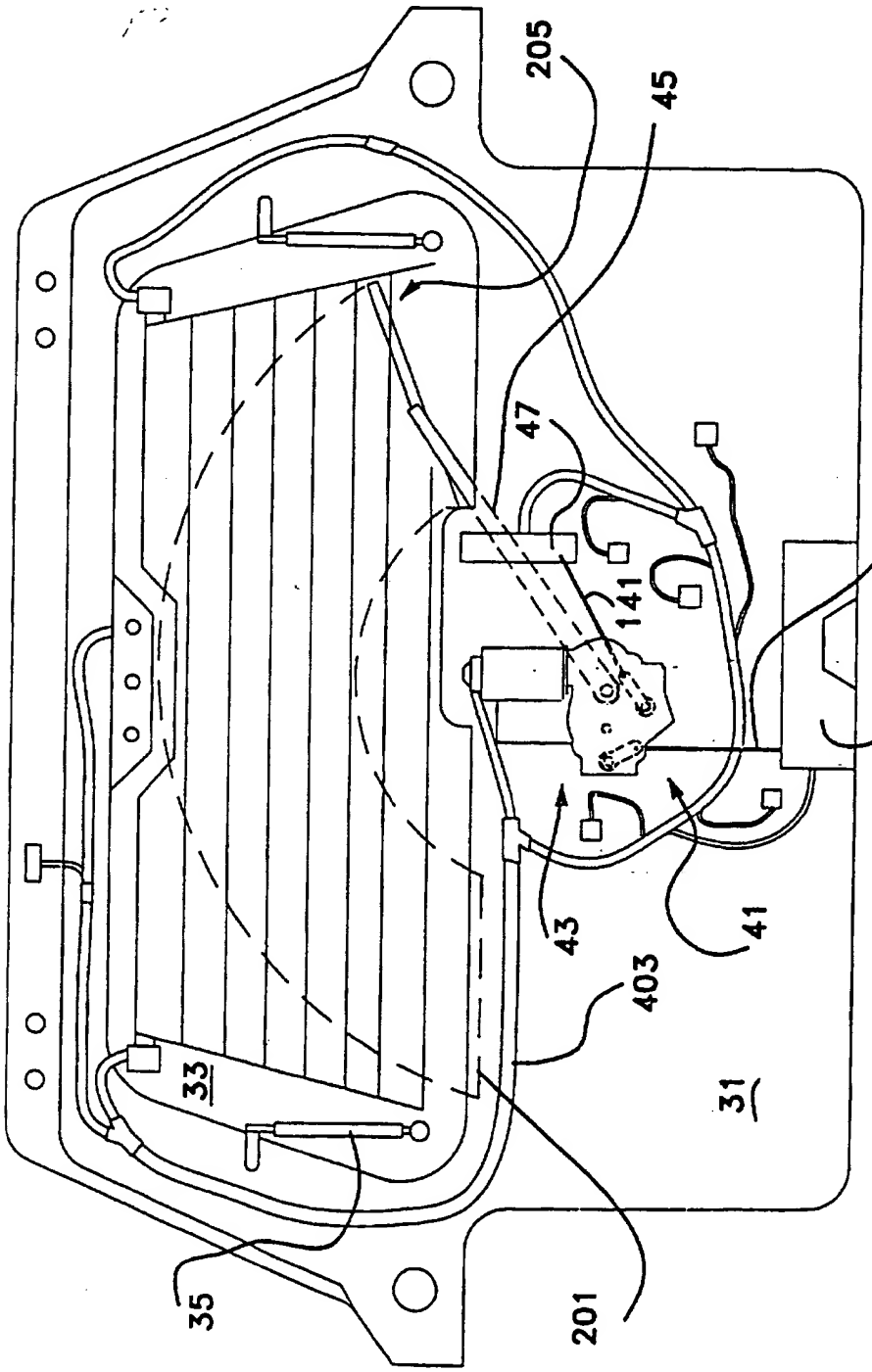
56. A method for operating a multi-functional apparatus for use in an automotive vehicle, said method comprising the step of preventing a wiper shaft from moving from a park position during movement of a lock coupling mechanism from a locked orientation to an unlocked orientation thereof.

57. The method of Claim 56 further comprising the step of mechanically blocking movement of an intermittent motion mechanism coupled to said wiper shaft thereby selectively preventing undesired movement thereof.

58. The method of Claim 57 further comprising the steps of selectively rotating said intermittent motion mechanism by engaging a portion thereof with a driving interface member, said driving interface member selectively moving with a rotating member, an electric motor selectively driving said rotating member, preventing said intermittent motion mechanism from rotating more than 359°.

59. The method of Claim 56 further comprising the step of substantially preventing movement of said lock between said locked orientation and said unlocked orientation thereof during cyclical wiping movement of said wiper shaft.

Fig-1



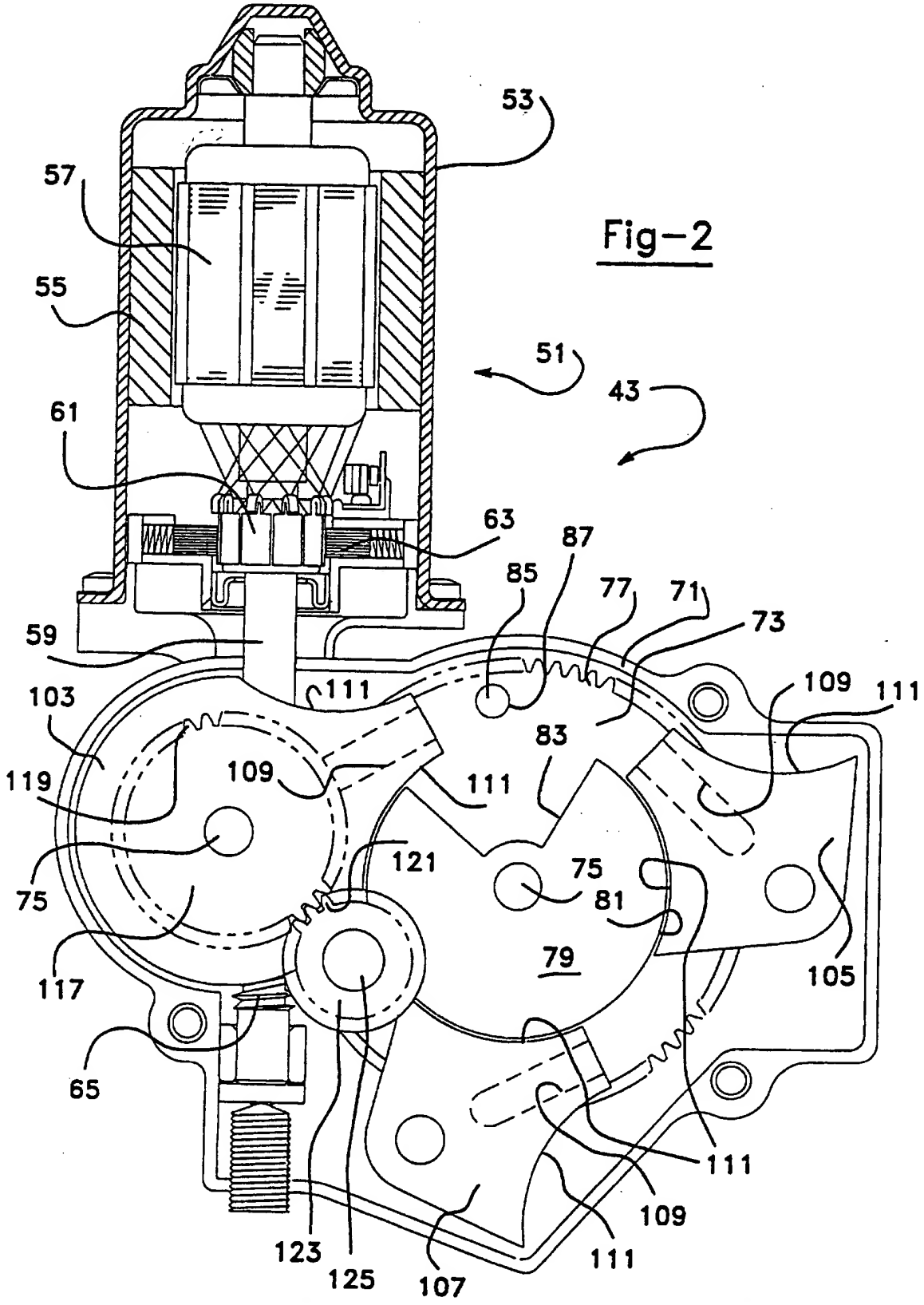

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Fig-2

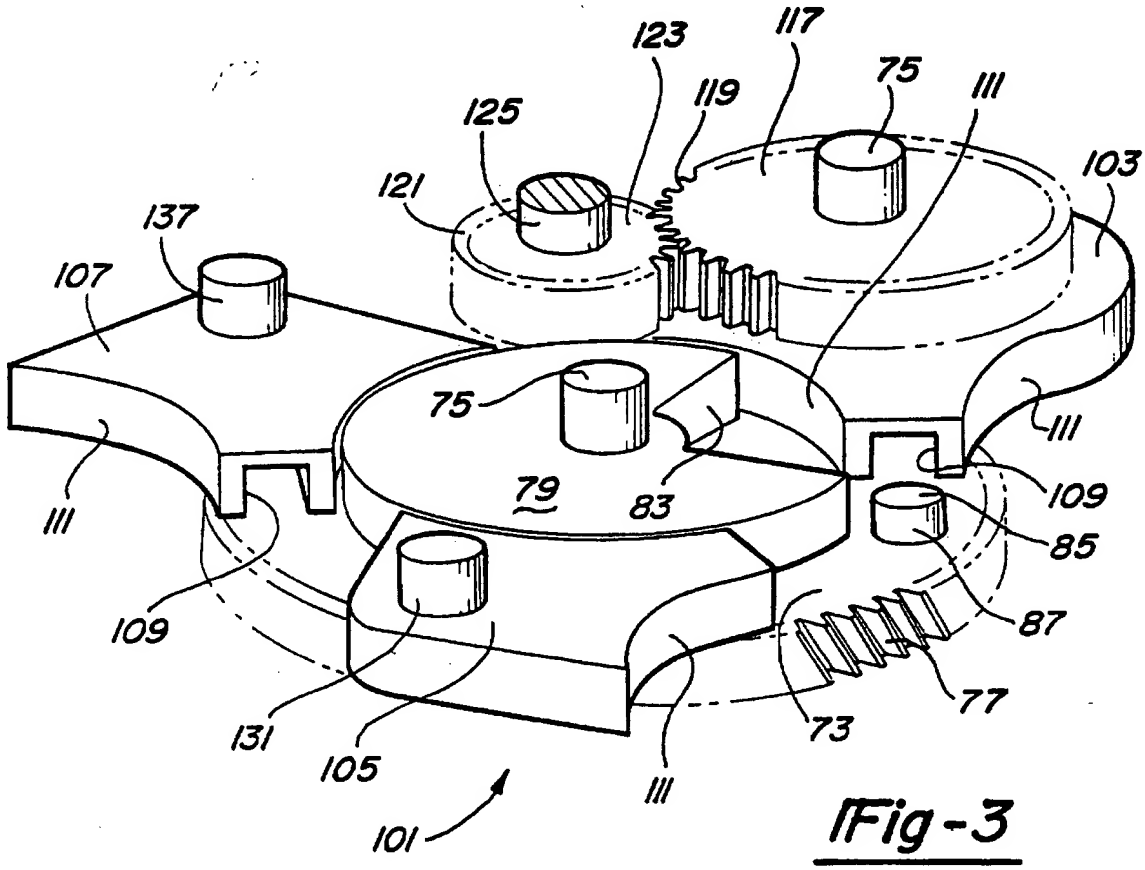
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Fig-3

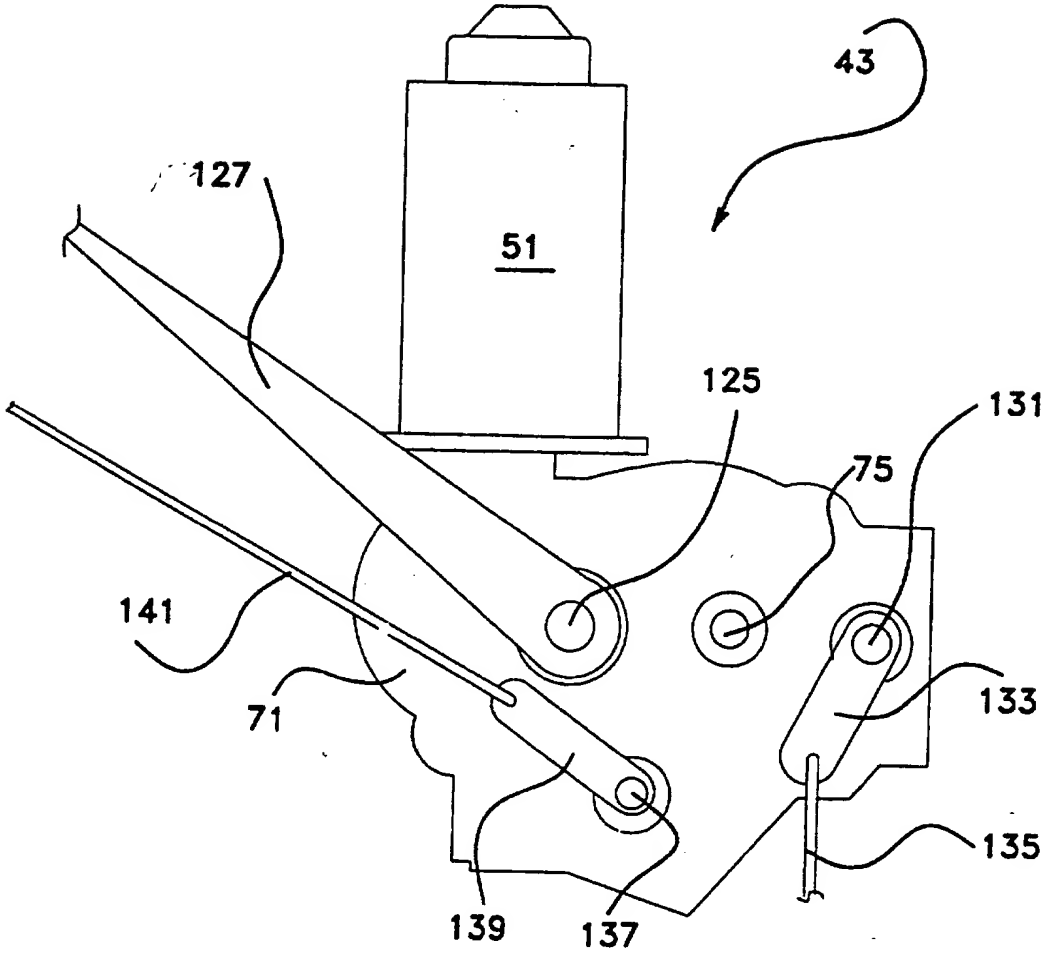


Fig-4

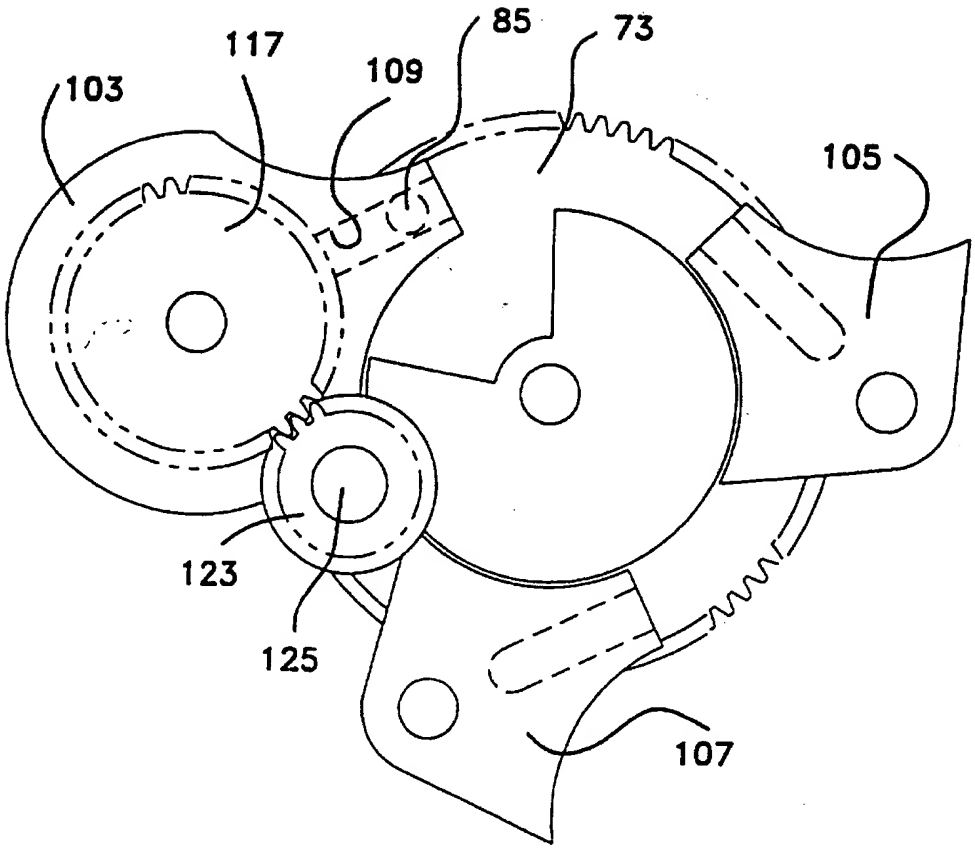


Fig-5

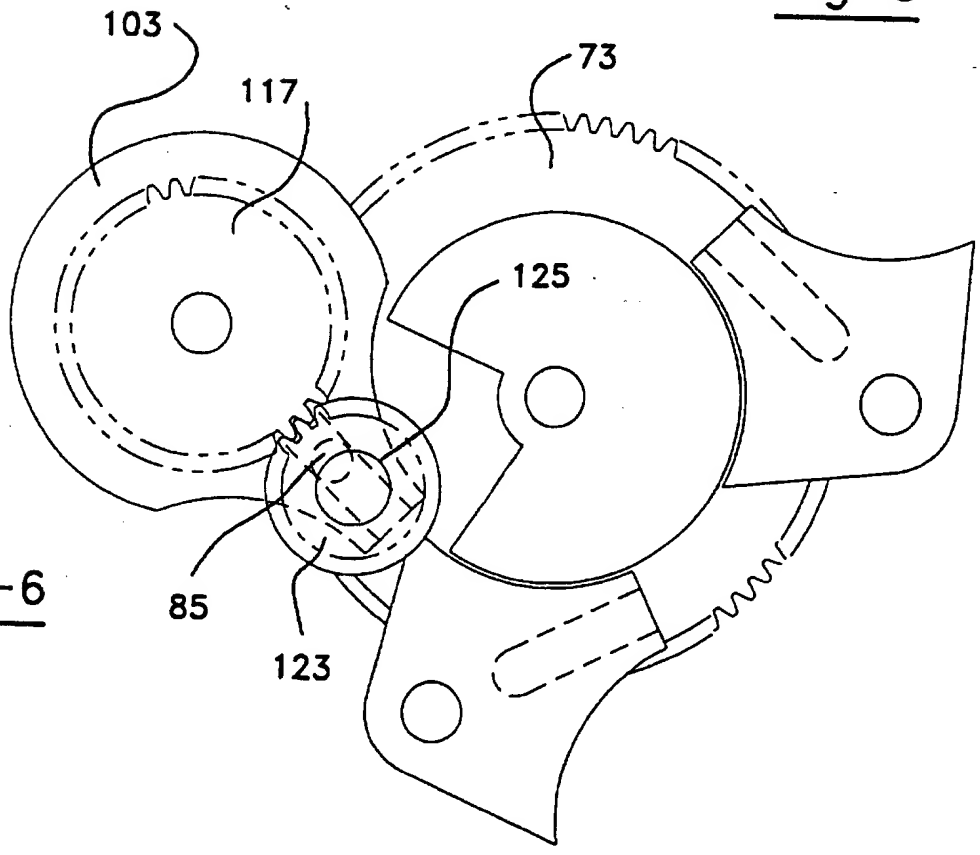


Fig-6

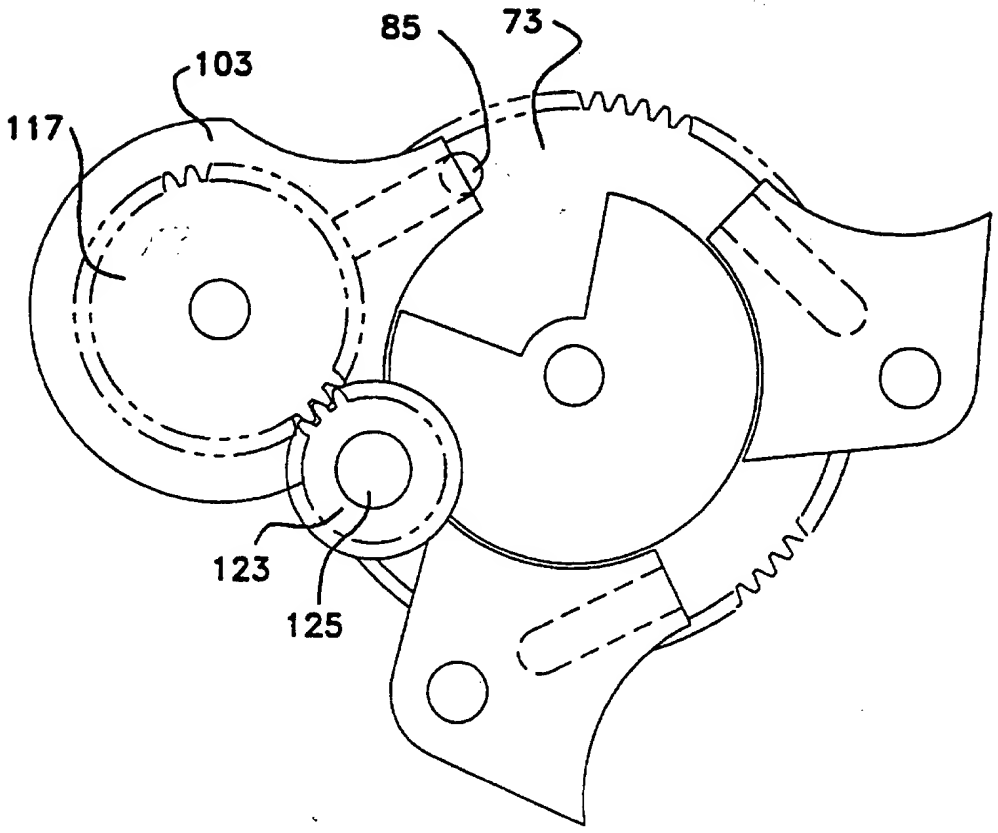


Fig-7

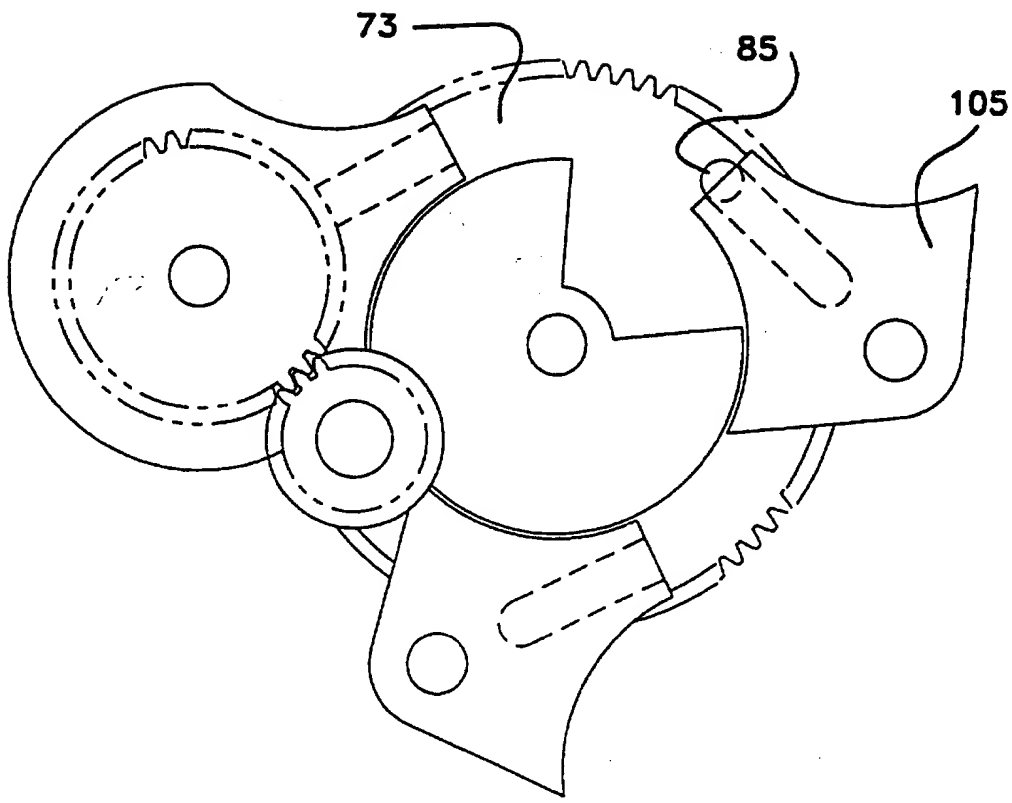


Fig-8

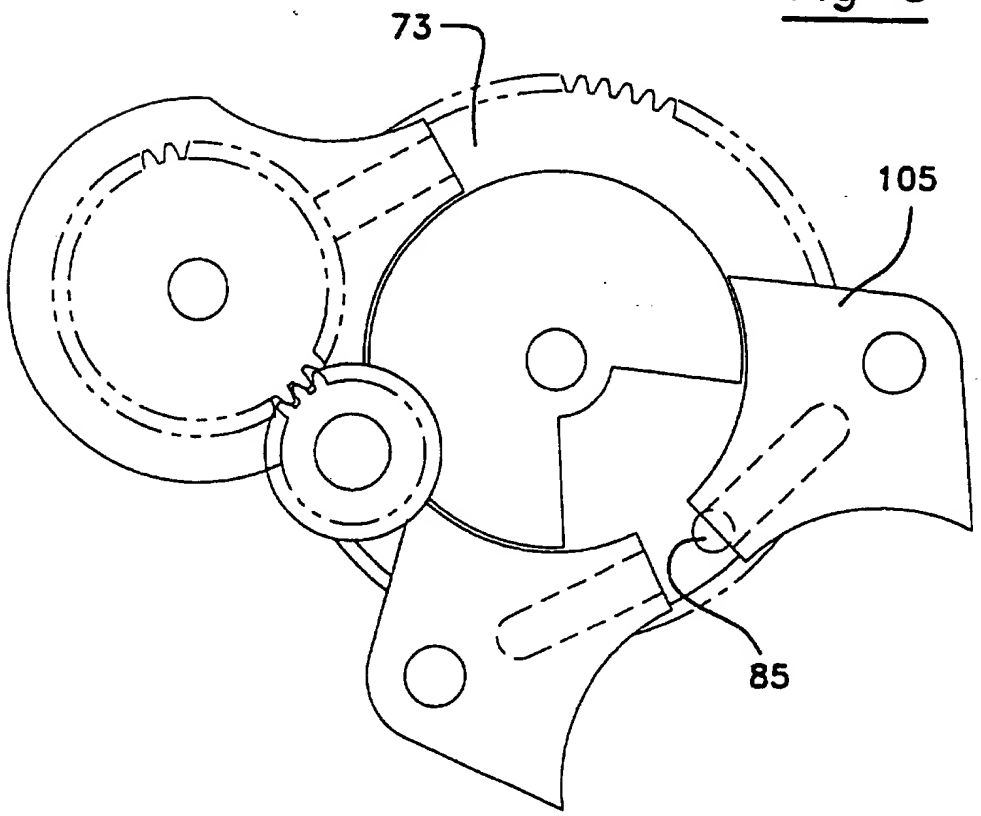


Fig-9

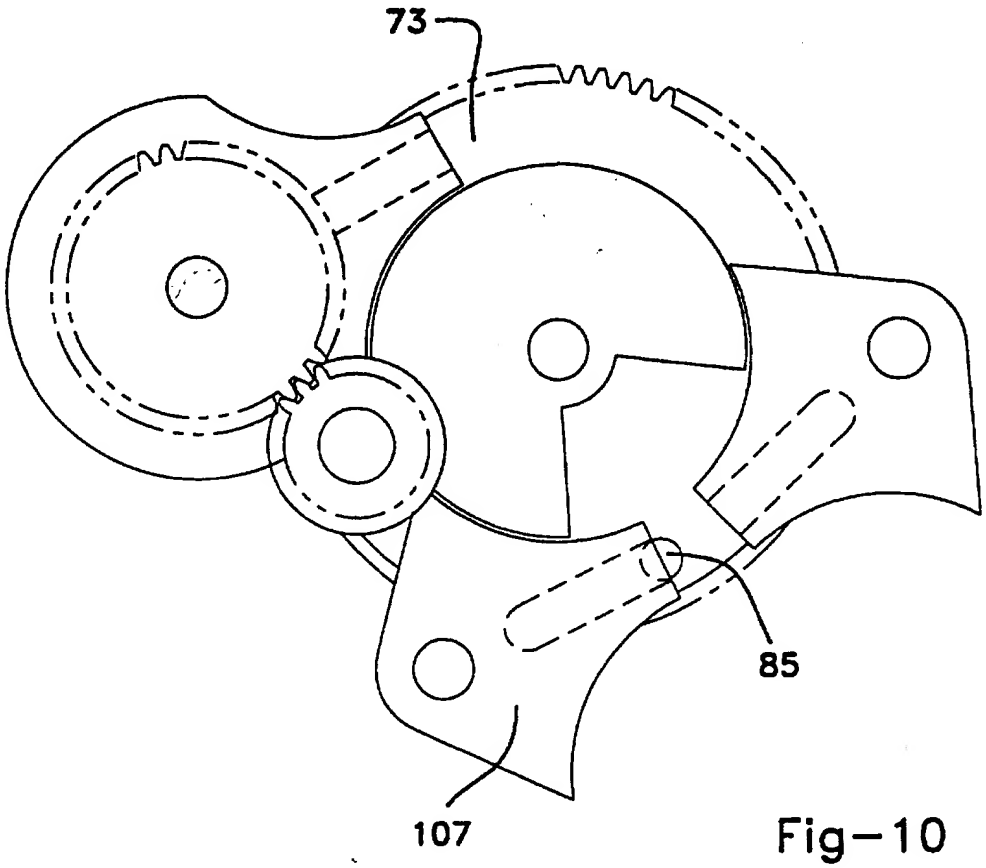


Fig-10

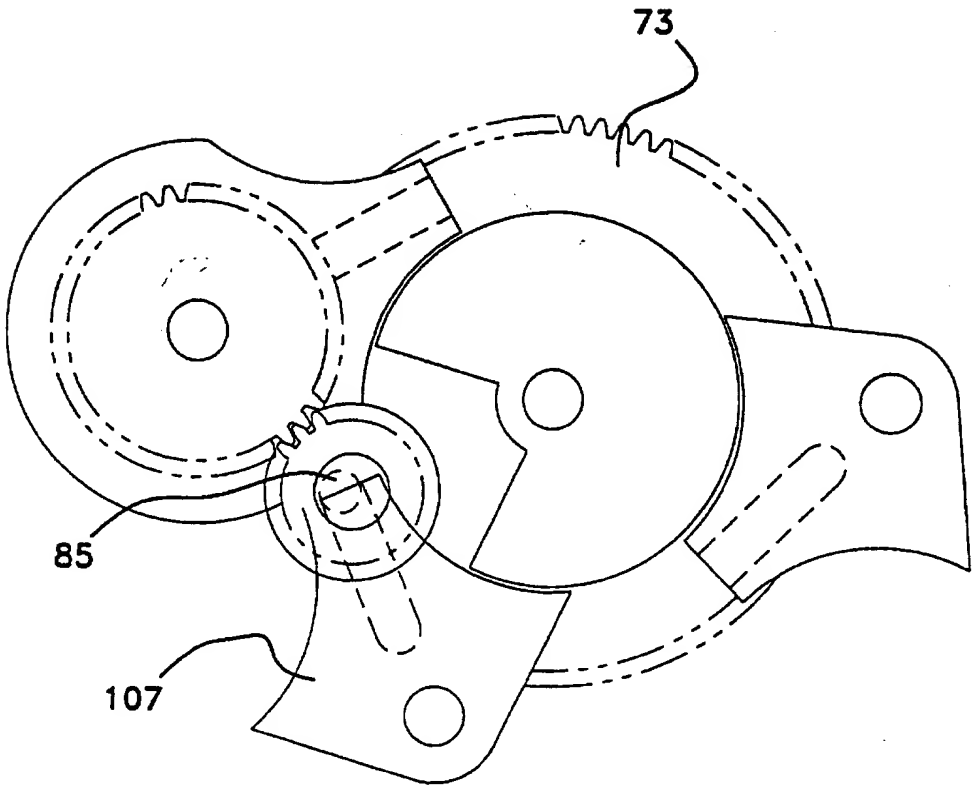
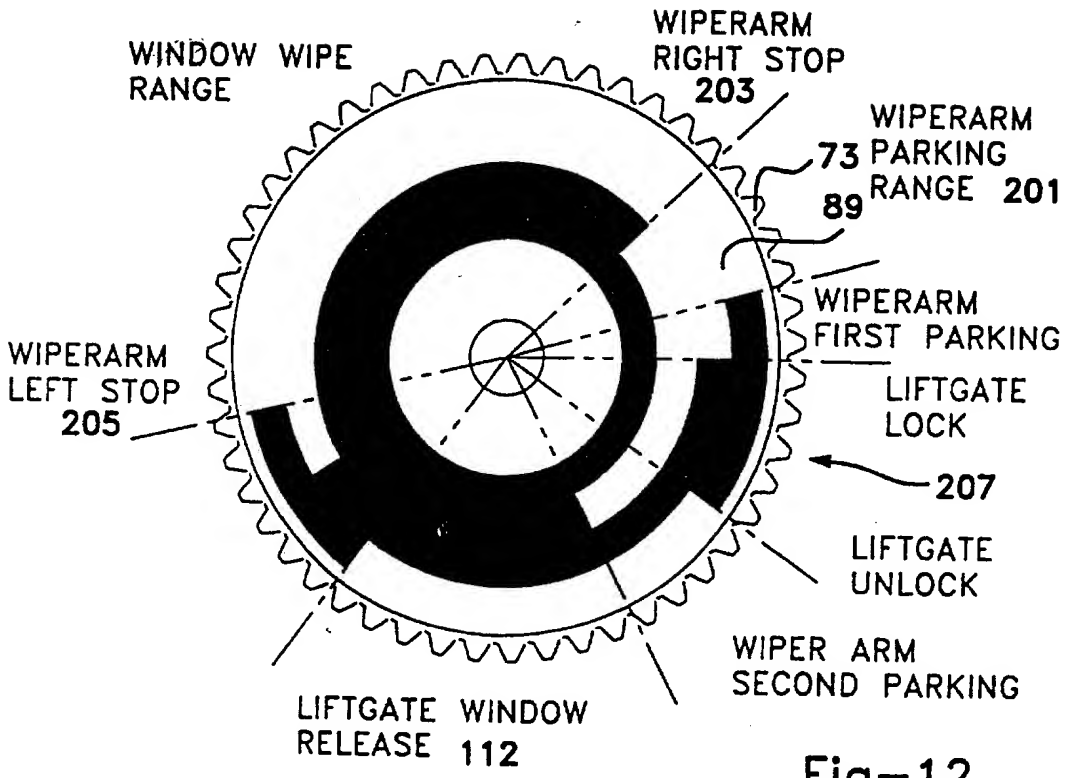


Fig-11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WIPERARM PARKING RANGE 201
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WIPERARM FIRST PARKING
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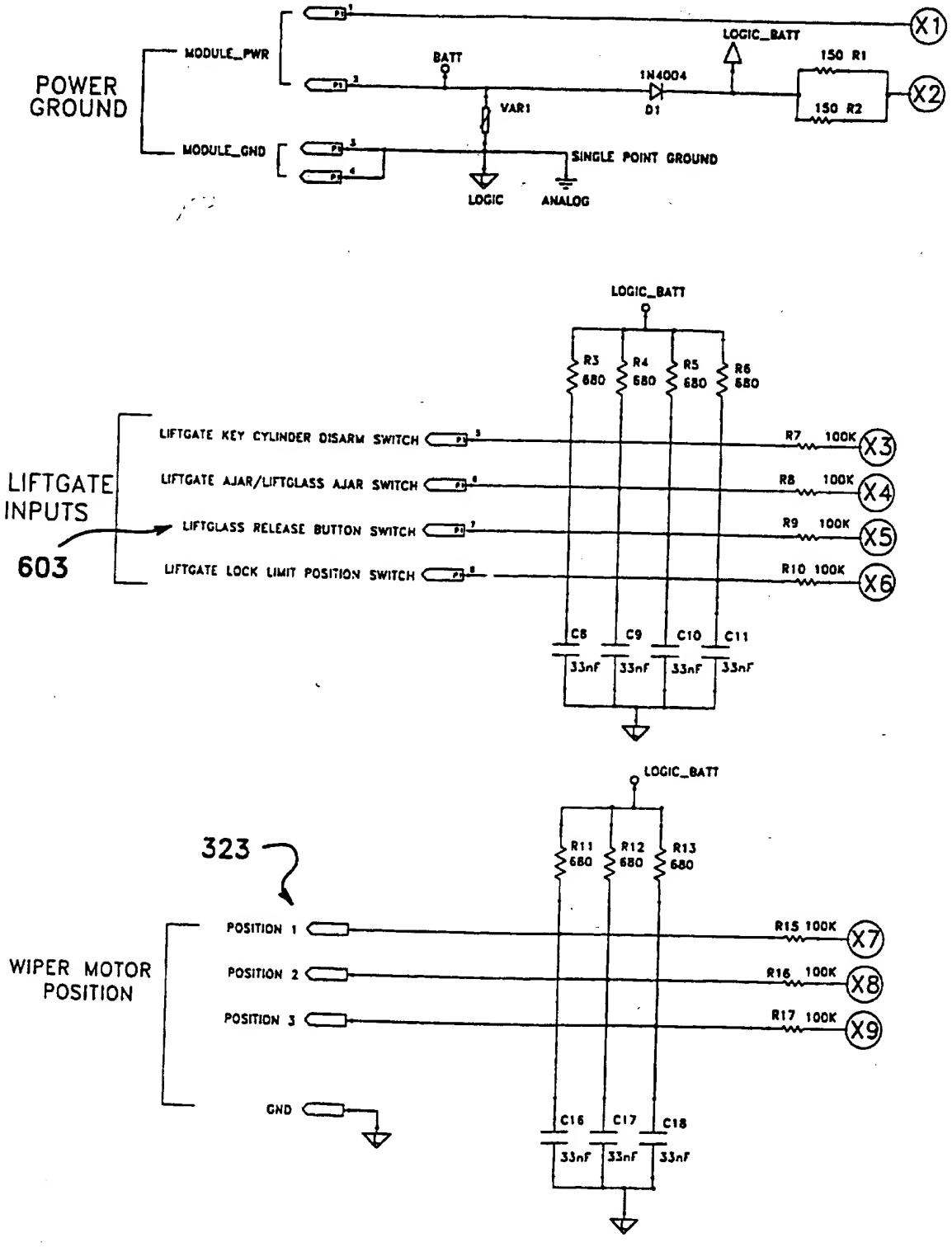
LIFTGATE UNLOCK
WIPER ARM SECOND PARKING
LIFTGATE WINDOW RELEASE 112
WIPERARM LEFT STOP 205

Fig-12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ANALOG
LOGIC_BATT
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R4 680
R5 680
R6 680
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LIFTGLASS RELEASE BUTTON SWITCH
LIFTGATE LOCK LIMIT POSITION SWITCH
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R8 100K
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R10 100K
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X5
X6
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C10 33nF
C11 33nF
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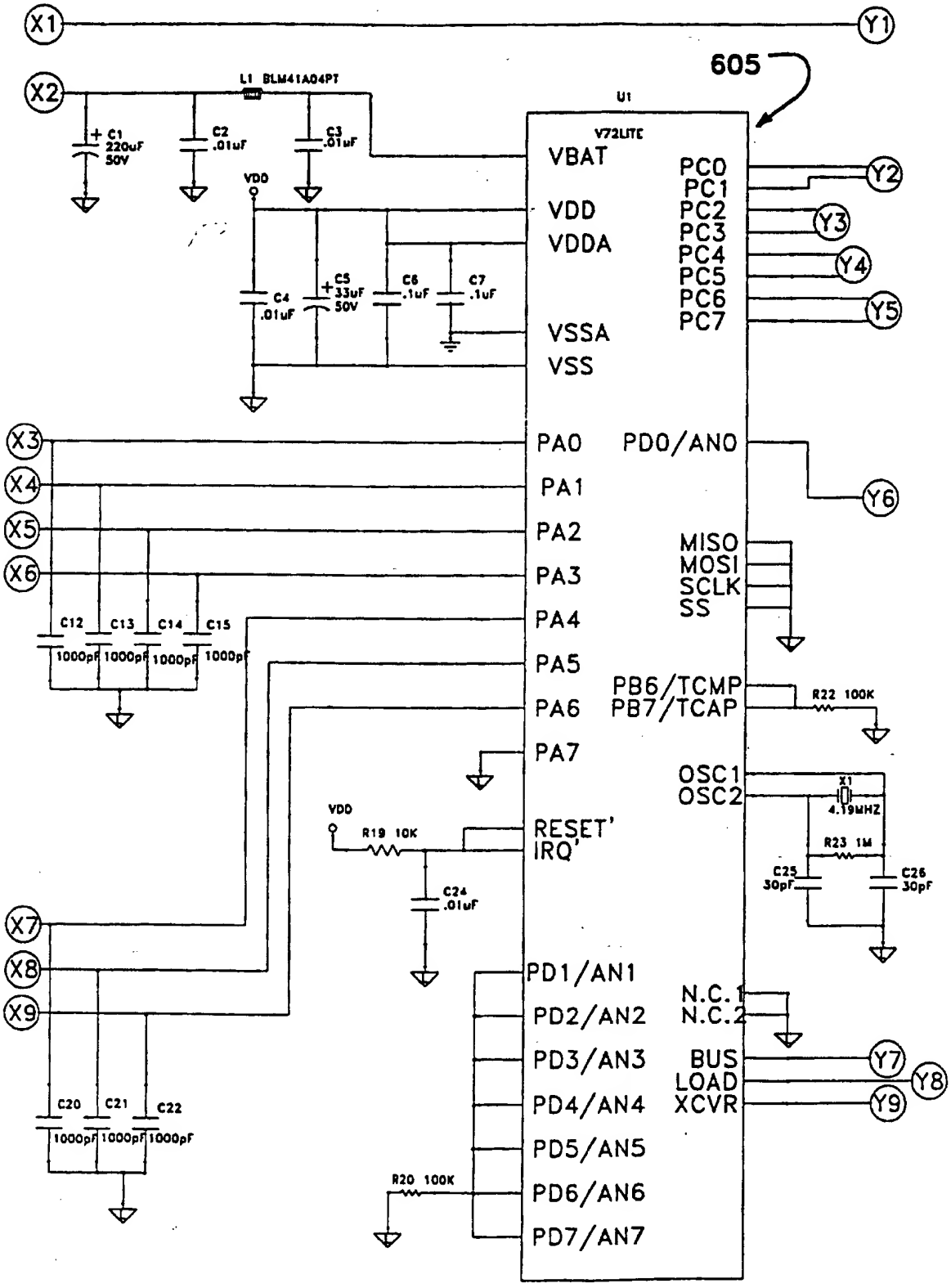
C18 33nF

Fig-13a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X6
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R19 10K
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IRQ'
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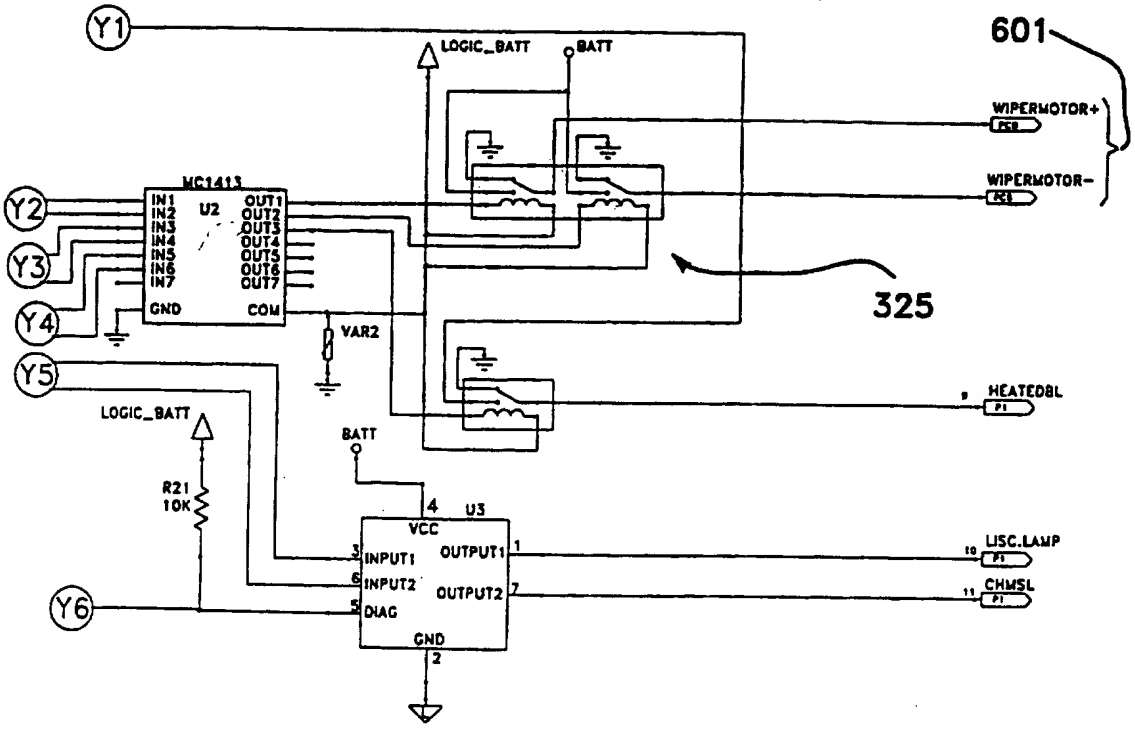
Fig-13b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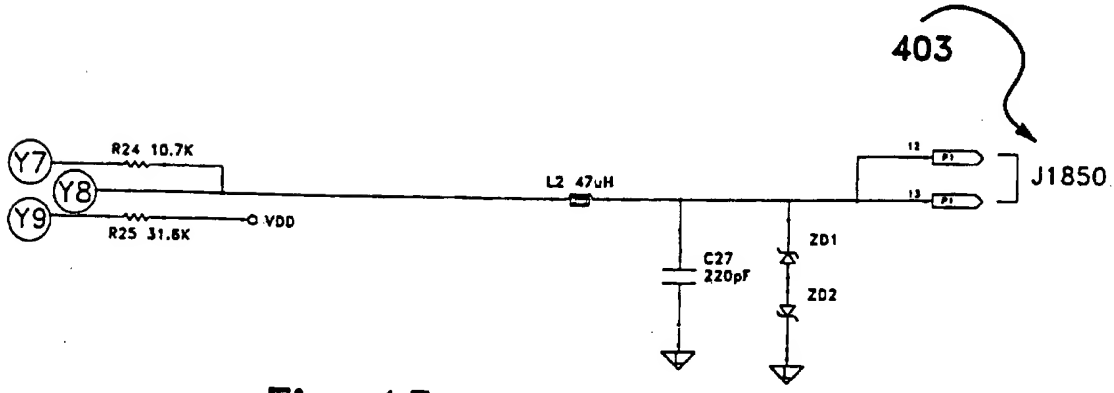
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Fig-13c

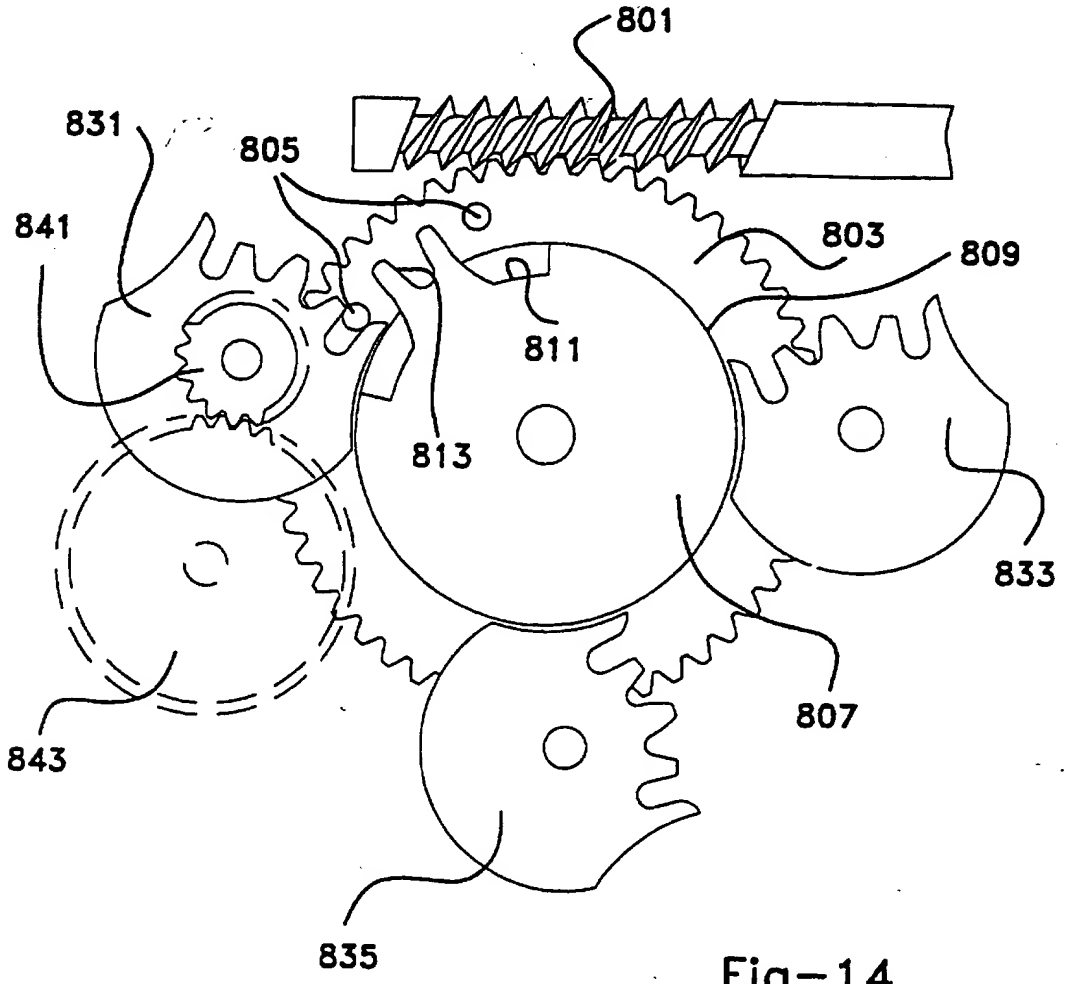

Fig-14

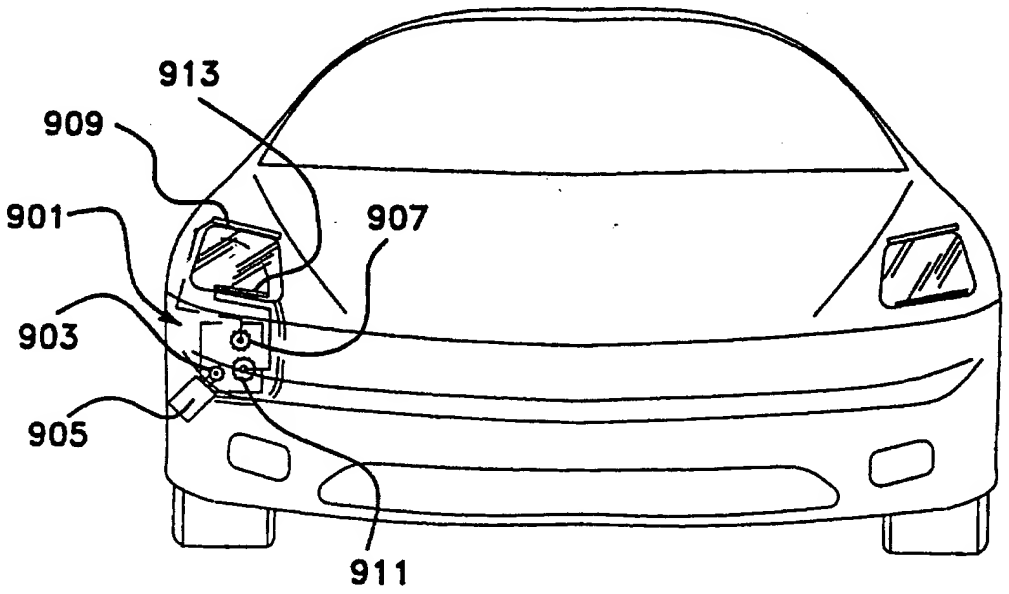

Fig-15

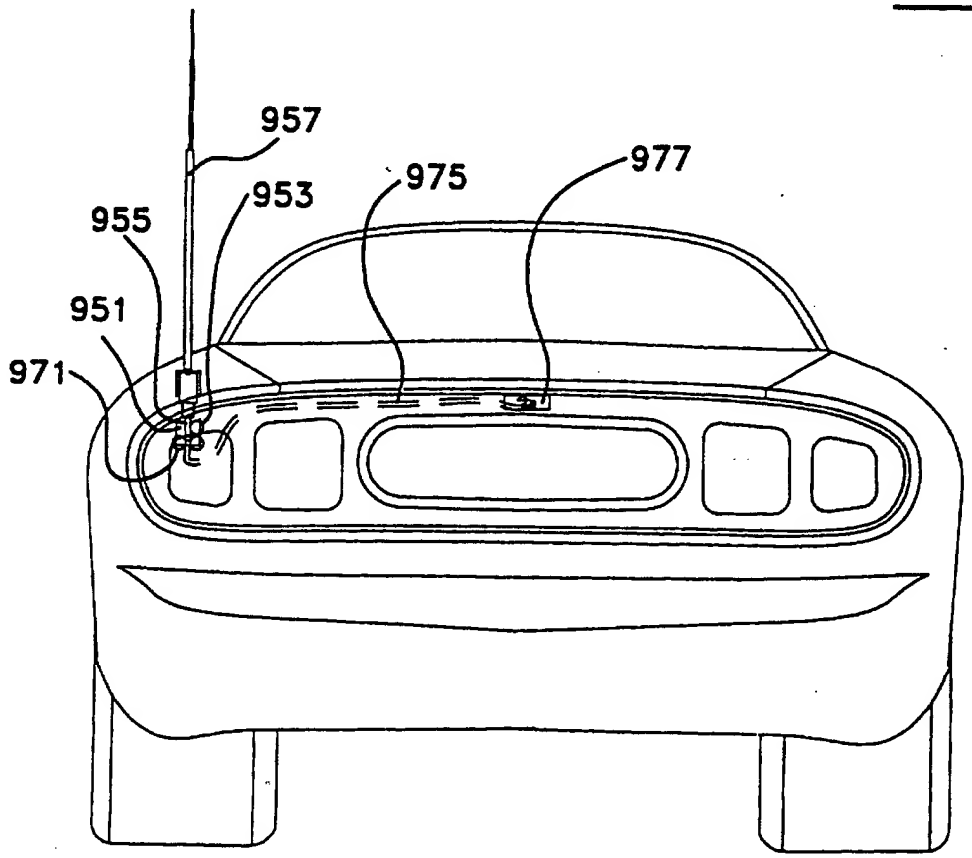

Fig-16

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 96/04520

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B60S1/18 H01Q1/10 B60Q1/05 E05B47/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B60S F16H E05B H01Q B60Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	DE,A,38 07 087 (AUDI AG) 14 September 1989 see the whole document	33,35 26,27,38 1,13,14, 25,39, 55,56,59
X Y A	EP,A,0 267 423 (AISIN SEIKI) 18 May 1988 see the whole document	25,28-30 26,27, 29,30 1,14,33
X Y A	US,A,3 361 005 (CARPENTER) 2 January 1968 see the whole document	46,51-53 50,54 1,11,14, 16,23, 25,28, 29,36,43

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

3

Date of the actual completion of the international search	Date of mailing of the international search report
13 September 1996	18. 09. 96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Westland, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 96/04520

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A,4 336 482 (GOERTLER ET AL) 22 June 1982 cited in the application	38
A	see the whole document	1,3,14, 21,33, 35,39, 55,56

Y	MACHINE DESIGN, vol. 60, no. 24, 13 October 1988, CLEVELAND, OHIO, US, page 100 XP000094453 "GENEVA MECHANISM, STAR WHEELS"	29,30,54
A	see the whole document	1,4,10, 11,15, 22,23, 25,28, 36,40, 43-46, 52,53, 55-57

Y	US,A,4 630 178 (MUGFORD ET AL) 16 December 1986	50
A	see the whole document	46

A	US,A,5 222 775 (KATO) 29 June 1993 cited in the application see the whole document	25-27, 39,55,56

A	US,A,4 875 053 (HARADA) 17 October 1989 see the whole document	40

A	GB,A,1 448 892 (CHRYSLER UK) 8 September 1976 see the whole document	56

A	US,A,4 869 126 (RUSS) 26 September 1989 see the whole document	1,14,33, 55

A	US,A,4 599 546 (UEMURA) 8 July 1986 see the whole document	1,14,15, 33,35, 39,55

A	US,A,4 173 055 (IZUMI ET AL) 6 November 1979 cited in the application see the whole document	1,14,33, 39,46, 48,49,55
	---	
3 21 A	US,A,4 702 117 (TSUTSUMI ET AL) 27 October 1987 see the whole document	25,31,32

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Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 96/ 04520

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

CLAIMS 1-13, 14-24, 33-38, 39, 55
CLAIMS 25-32
CLAIMS 40-45
CLAIMS 46-54
CLAIMS 56-59

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

ational Application No
PCT/US 96/04520

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	National Application No
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